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10/051,183	01/22/2002	Otto Z. Zhou	032566-017	9917

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EXAMINER
SONG, HOON K

ART UNIT	PAPER NUMBER
2882	

DATE MAILED: 09/10/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/051,183	ZHOU ET AL.	
	Examiner	Art Unit	
	Hoon Song	2882	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-59* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-59* is/are rejected.

7)☒ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *22 January 2002* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *4* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 24-26, 28-30, 32-33 and 35-59 are rejected under 35 U.S.C. 102(e) as being anticipated by Whitlock et al. (US 6333968B1).

Regarding claim 24, Whitlock teaches a structure to generate x-rays comprising:

a plurality of stationary and individually electrically addressable electron sources defining a plurality of cathodes (figure 3);

at least one target placed opposing the cathodes (figure 3); and

an evacuated chamber that houses the plurality of cathodes and the at least one target (figure 3).

Regarding claim 25, Whitlock teaches that the electron sources are field emission electron sources (figure 3).

Regarding claim 26, Whitlock teaches that each electron field emission source is a triode-type comprising a field emissive material and a gate electrode

positioned parallel to and insulated from a substrate, and wherein a plurality of electrons are field emitted from the cathode when the electric field between the gate

electrode and the field emissive material exceeds a threshold value, and wherein the plurality of field emitted electrons pass the gate electrode and are further accelerated to impact on the at least one target by an electric field applied between the gate electrode and the at least one target, and wherein, upon impact, at an incidence point, at least one x-ray having a characteristic wavelength corresponding to a material of the at least one target and at least one x-ray having a continuous wavelength are generated (figure2b).

Regarding claim 28, Whitlock teaches that the field emissive material is coated on the substrate as a film, is embedded in a matrix of the substrate, or is a free-standing substrate structure, and the gate electrode is disposed across a surface of the substrate substantially equidistant from the substrate (figure 2b).

Regarding claim 29, Whitlock teaches that an evacuated chamber with a plurality of x-ray transparent windows, each window positioned to allow the passage of at least one x-ray beam generated by a plurality of electrons from a corresponding one of the plurality of cathodes, wherein the plurality of cathodes and the at least one target are disposed within the evacuated chamber and the evacuated chamber is operationally maintained at a pressure lower than 10-3 Torr (figure 3).

Regarding claim 30, Whitlock teaches that the plurality of cathodes and the at least one target are each on an opposing plane and the target has a deflection surface that is oriented toward a surface of the plurality of cathodes that emits electrons (figure 4).

Regarding claim 32, Whitlock teaches that each of the plurality of cathodes

are individually positioned on one of the opposing planes at a pre-determined interval (figure 2e).

Regarding claim 33, Whitlock teaches that the plurality of cathodes are disposed on a first ring (208) and the at least one target is disposed on a second (198) ring, the first and second rings concentric (figure 6d), and the at least one target has a deflection surface that is oriented toward a surface of the plurality of cathodes that emits electrons (figure 6d).

Regarding claim 35, Whitlock teaches that each of the plurality of cathodes are individually positioned on one of the first or second rings at a pre-determined Interval (figure 6d).

Regarding claim 36, Whitlock teaches a device to record x-ray images, comprising (figure 8a):

an x-ray source comprising a plurality of stationary and individually electrically addressable electron sources defining a plurality of cathodes, the plurality of cathodes disposed on a face of a first planar surface, at least one target disposed on a second planar surface, a deflection surface of the second planar surface opposing the face of the first planar surface, and an evacuated chamber that houses the plurality of cathodes and the at least one target,

an array or matrix of x-ray detectors or x-ray sensitive films opposing the x-ray source, the array or matrix substantially parallel to and at equal distance to the x-ray source; and

an object positioner placed between the x-ray source and the array or matrix (figure 8a).

Regarding claim 37, Whitlock teaches that the detection surface is oriented substantially parallel to the face of the plurality of cathodes that emits electrons (figure 7).

Regarding claim 38, Whitlock teaches that each of the plurality of electron sources are individually positioned at a pre-determined interval on the face of the plurality of cathodes (figure 10).

Regarding claim 39, Whitlock teaches that the x-ray source further comprises a plurality of x-ray transparent windows disposed in a wall of the evacuated chamber, and a plurality of parallel collimators, at least one parallel collimator on each one of the plurality of x-ray transparent windows (figure 10).

Regarding claim 40, Whitlock teaches that the object positioner is movable with respect to the x-ray source (well known).

Regarding claim 41, Whitlock teaches that the detector is a stationary positioned charged coupled device (detector).

Regarding claim 42, Whitlock teaches a method to obtain an x-ray image, the method comprising:

placing an object in an x-ray source, the x-ray source comprising a plurality of stationary and individually electrically addressable electron sources defining a plurality of cathodes, the plurality of cathodes disposed on a face of a first planar surface, at least one target disposed on a second planar surface a

deflection surface of the second planar surface opposing the face of the first planar surface, and an evacuated chamber that houses the plurality of cathodes and the at least one target, an array or matrix of x-ray detectors or x-ray sensitive films opposing the x-ray source, the array or matrix substantially parallel to and at equal distance to the x-ray source, and an object positioner placed between the x-ray source and the array or matrix (figure 6d);

applying power to at least one of the plurality of cathodes to generate x-ray radiation for a pre-set exposure time;

exposing the object to the x-ray radiation; and

capturing an x-ray image corresponding to the object by either the x-ray detectors or the x-ray sensitive films (figure 7).

Regarding claim 43, Whitlock teaches that the power is applied to all of the plurality of cathodes simultaneously (figure 3).

Regarding claim 44, Whitlock teaches that the power is applied to a subset of the plurality of cathodes sequentially at a pre-set or variably-set frequency (well known).

Regarding claim 45, Whitlock teaches that moving or activating the x-ray detectors or the x-ray sensitive films at a corresponding frequency to the pre-set or variably-set frequency to capture the x-ray image (figure 6d).

Regarding claim 46, Whitlock teaches that a detecting means used in the step of detecting is a charge-coupled device, the charge-coupled device stationary positioned to detect the emitted x-ray (figure 7).

Regarding claim 47, Whitlock teaches that a step of transferring a detected image resulting from the step of detecting to a computer storage device and refreshing a detecting means for a next image (well known).

Regarding claim 48, Whitlock teaches a device to record x-ray images comprising:

an x-ray source comprising a plurality of stationary and individually electrically addressable electron sources defining a plurality of cathodes, the plurality of cathodes disposed on a surface of a first ring (208), at least one target disposed on a second ring (198), a deflection surface of the second ring opposing the surface of the first ring, and an evacuated chamber that houses the plurality of cathodes and the at least one target (figure 6d);

an array or matrix of x-ray detectors or x-ray sensitive films on a surface opposing the x-ray source, the array or matrix substantially concentric to and at equal distance to the x-ray source (figure 6d); and

an object positioner placed between the x-ray source and the array or matrix (figure 6d).

Regarding claim 49, Whitlock teaches that the first (208) and second (198) ring are concentric (figure 6d).

Regarding claim 50, Whitlock teaches that each of the plurality of electron sources are individually positioned at a pre-determined interval on the surface of the ring (figure 6d).

Regarding claim 51, Whitlock teaches that the x-ray source further comprises

a plurality of x-ray transparent windows disposed in a wall of the evacuated chamber a plurality of parallel collimators, at least one parallel collimator on each one of the plurality of x-ray transparent windows (figure 10).

Regarding claim 52, Whitlock teaches that the object positioner is movable with respect to the x-ray source (well known).

Regarding claim 53, Whitlock teaches that the detector is a stationary positioned charged coupled device.

Regarding claim 54, Whitlock teaches a method to obtain an x-ray image, the method comprising:

placing an object in an x-ray source, the x-ray source comprising a plurality of stationary and individually electrically addressable electron sources defining a plurality of cathodes, the plurality of cathodes disposed on a surface of a first ring (see where numeral 208 indicates), at least one target disposed on a second ring (see where numeral 198 indicate), a deflection surface of the second ring opposing the surface of the first ring, and an evacuated chamber that houses the plurality of cathodes and the at least one target, an array or matrix of x-ray detectors or x-ray sensitive films on a surface opposing the x-ray source, the array of matrix substantially concentric (figure 6d) to and at equal distance to the x-ray source, and an object positioner (206) placed between the x-ray source and the array or matrix; applying power to all of the plurality of cathodes to generate x-ray radiation for a pre-set exposure time;

exposing the object to the x-ray radiation; and

capturing an x-ray image corresponding to the object by either the x-ray detectors or the x-ray sensitive films (figure 6d).

Regarding claim 54, Whitlock teaches that the power is applied to all of the plurality of cathodes simultaneously (figure 6d).

Regarding claim 56, Whitlock teaches that the power is applied to a subset of the plurality of cathodes sequentially at a pre-set or variably-set frequency (figure 6d).

Regarding claim 57, Whitlock teaches that activating the x-ray detectors or the x-ray sensitive films at a corresponding frequency to the pre-set or variably-set frequency to capture the x-ray image (figure 6d).

Regarding claim 58, Whitlock teaches that a detecting means used in the step of capturing an x-ray image is a charge-coupled device, the charge-coupled device stationary positioned to detect the x-ray radiation (212).

Regarding claim 59, Whitlock teaches that a step of transferring a detected image resulting from the step of capturing an x-ray image to a computer storage device and refreshing a detecting means for a next x-ray image (well known).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of

the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1-6 and 9-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Whitlock et al. (US 6333968B1) in view of Baptist (US 6259765B1).

Regarding claim 1, Whitlock teaches a structure to generate x-rays comprising:

a stationary cathode structure having a plurality of stationary and individually electrically addressable field emissive electron sources defining a plurality of cathodes, each cathode disposed on a first side of the cathode structure (figure 6b),

a stationary target structure;

an object positioner disposed within an imaging zone (figure 5a); and

a detector operatively positioned within the structure to receive and detect an x-ray from the target (figure 5a),

wherein each cathode comprises a substrate and a gate electrode positioned parallel to and insulated from the substrate, the substrate comprising a field emissive material (figure 2f).

but fails to teach that a stationary target structure having a deflection surface oriented non-perpendicularly to the first side of the cathode structure, the deflection surface defining a target.

Baptist teaches the non-parallel target (10).

In view of Baptist, one would be motivated to adopt the non-parallel target because it would send a large quantity of X-rays towards the window (column 8 line 9+).

Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Whitlock as modified by Baptist as applied to claim 1 above, and further in view of Takahashi (US 6456691B2).

Regarding claim 2, Whitlock as modified by Baptist fails to teach that the field emissive material is selected from carbon nanotubes.

Takahashi teaches a carbon nanotube type field emission X-ray source.

In view of Takahashi, it would have been obvious to an artisan of ordinary skill in the art at the time the invention was made to adopt the known x-ray source type because it has superior thermal and electrical characteristic than hot cathode type source. Accordingly one would be motivated to adopt the carbon nanotube type source because it would provide low temperature heating, low current and steady emission current (column 2 line 37+)

Regarding claim 3, Whitlock teaches that each of the plurality of cathodes is a recessed well in the cathode structure and into which the substrate is disposed, and the gate electrode is disposed across the surface of the substrate substantially equidistant from the substrate (figure 2f).

Regarding claim 4, Whitlock teaches that the plurality of cathodes are each individually positioned on the first surface of the cathode structure at a predetermined interval (figure 2f).

Regarding claim 5, Whitlock teaches that the predetermined interval is approximately 10 to 120 (figure 2f).

Regarding claim 6, Whitlock teaches that the target is an area array of target material or a plurality of individual target material (figure 4).

Regarding claim 9, Whitlock teaches that the target is an area array of individual target material or a line array of target material (figure 4).

Regarding claim 10, Whitlock teaches that the detector is a stationary positioned charged-coupled device (196).

Claims 7-8, 11, 13-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Whitlock in view of Wiesent et al. (US 5377249).

Regarding claims 7-8 and 11, Whitlock teaches a method of generating an x-ray image comprising the steps of:

positioning an object within an imaging zone;

switching each of a plurality of cathodes on a stationary cathode structure at a predetermined frequency to field emit an electron, each of the plurality of cathodes individually addressable and electrically switched in a programmable sequence to field emit electrons toward an incidence point on a stationary target structure, the cathode comprising a field emissive electron source;

emitting an x-ray from a target of the stationary target structure at the predetermined frequency;

imaging the object; and

detecting the emitted x-ray

however Whitlock fails to teach a configuration of the imaging structure.

Wiesent teaches the configuration of the imaging structure wherein a position on the stationary target structure (3) from which the x-ray emits corresponds spatially and temporally to a position on the cathode structure from which the electron emits, and wherein at least one of a circumferential position and an elevation angle of the emitted x-ray (5)is sufficiently discriminated with respect to the object (11) to produce three dimensional image.

In view of Wiesent, it would have been obvious to an artisan of ordinary skill in the art at the time the invention was made to adopt the known configuration of an x-ray imaging apparatus in order to design a system that can produce three dimensional image. Accordingly, one would be motivated to adopt the imaging structure because a double partial ring design are preserved such as the cost and equipment savings in only having to construct partial, as opposed to complete, anode and detector rings (column 3 line 31+).

Regarding claim 12, Whitlock as modified by Wiesent fails to teach that the field emissive material is selected from carbon nanotubes.

Takahashi teaches a carbon nanotube type field emission X-ray source.
In view of Takahashi, it would have been obvious to an artisan of ordinary skill in the art at the time the invention was made to adopt the known x-ray source type because it has superior thermal and electrical characteristic than hot cathode type source. Accordingly one would be motivated to adopt the carbon nanotube type source because it would

provide low temperature heating, low current and steady emission current (column 2 line 37+)

Regarding claim 13, Whitlock teaches that the predetermined frequency is in the range of 0.1 Hz to100 kHz (figure 3).

Regarding claim 14, Whitlock teaches that the predetermined frequency is sufficiently rapid to dynamically image a physiological function (figure 3).

Regarding claim 15, Whitlock teaches that the electron is non-divergent and accelerated from a field emissive material toward a gate electrode and impacts the target at an incidence point (figure 3).

Regarding claim 16, Whitlock teaches that the step of emitting an x-ray forms a pencil-like x-ray beam, the x-ray beam corresponding to one or more pixels of a detecting means utilized in the step of detecting (well known).

Regarding claim 17, Whitlock teaches that the x-ray beam corresponds to no more than ten pixels (figure 4).

Regarding claim 18, Whitlock teaches that the step of emitting an x-ray forms a fan-like x-ray beam, the x-ray beam corresponding to one or more lines of pixels of a detecting means utilized in the step of detecting (well known).

Regarding claim 19, Whitlock teaches that the x-ray beam corresponds to a line of no more than ten lines of pixels (figure 4).

Regarding claim 20, Whitlock teaches that the step of emitting an x-ray forms a cone-like x-ray beam, the x-ray beam corresponding to an area of no more than 128x128 square pixels of a detecting means utilized in the step of detecting (figure 4),

Regarding claim 21, Whitlock teaches that the x-ray beam corresponds to an area of no more than 64x64 square pixels (figure 4).

Regarding claim 22, Whitlock teaches that a detecting means used in the step of detecting is a charge-coupled device, the charge-coupled device stationary positioned to detect the emitted x-ray.

Regarding claim 23, Whitlock teaches that a step of transferring a detected image resulting from the step of detecting to a computer storage device and

refreshing a detecting means for a next image (well known).

Claim 27 is rejected under 35 U.S.C. 103(a) as being unpatentable over Whitlock in view of Takahashi et al. (US 6456691B2).

Regarding claim 27, Whitlock fails to teach that the field emissive material is selected from carbon nanotubes.

Takahashi teaches a carbon nanotube type field emission X-ray source.

In view of Takahashi, it would have been obvious to an artisan of ordinary skill in the art at the time the invention was made to adopt the known x-ray source type because it has superior thermal and electrical characteristic than hot cathode type source. Accordingly one would be motivated to adopt the carbon nanotube type source because it would provide low temperature heating, low current and steady emission current (column 2 line 37+)

Claims 31 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Whitlock in view of Baptist.

Whitlock fails to teach that a stationary target structure having a deflection surface oriented non-perpendicularly to the first side of the cathode structure, the deflection surface defining a target.

Baptist teaches the non-parallel target (10).

In view of Baptist, one would be motivated to adopt the non-parallel target because it would send a large quantity of X-rays towards certain direction the window (column 8 line 9+).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hoon Song whose telephone number is 703-308-2736. The examiner can normally be reached on 8:30 AM - 5 PM, Monday - Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edward Glick can be reached on 703-308-4858. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Hoon Song

Craig E Church

Craig E. Church
Primary Examiner